Radiochemical Detectors Probe Physical Processes

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Neutron reactions on radiochemical detector isotopes provide a key diagnostic for fusion yields and thus for the interpretation of Nevada Test Site data; for example, see Ref. [1, 2]. Our work focuses on the theoretical interpretation of radiochemical data and its role in the analysis of device performance. This includes sensitivity studies for nuclear data and the interaction between nuclear processes and other physical processes. As we have demonstrated previously [2, 3], radiochemical reactions provide a generic probe of neutron physics in the thermonuclear environment.

The main reactions of interest for diagnosing the high energy part of the neutron spectrum are (n,2n) reactions on detector isotopes such as yttrium and thulium. Because different detector isotopes have different thresholds for (n,2n) reactions, it is possible to obtain differential spectral information for the neutron energy distribution. Physical processes that lead to softening of the neutron spectrum are therefore open to investigation through comparison of isotopic yields in detector isotope chains. We are currently engaged in more detailed studies to parameterize the time-development of the neutron spectrum. A cartoon of the softening is shown in Fig. 1.

[1] Anna C. Hayes and Gerard Jungman, "Weapons Sensitivity Studies for Nuclear Physics (U)," Los Alamos National Laboratory internal memo (2004).
[2] Anna C. Hayes and Gerard Jungman, "Yttrium Equivalences in Weapons Radiochemistry and Fusion Yields," in *T-Division Activities in Support of the Nuclear Weapons Program: 2002/2003*, LA-UR-03-0001 (2003).
[3] Gerard Jungman, "The Physics of Yttrium Equivalence (U)," LA-CP-03-0538. Presented at the 2003 Nuclear Explosives Design Physics Conference.

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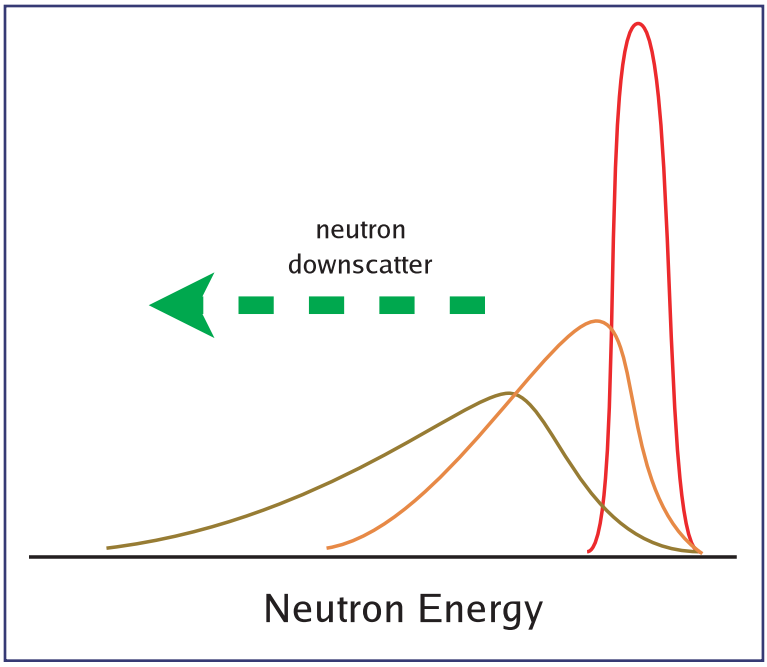

Figure 1—
The cartoon shows the softening of a neutron spectrum due to elastic scattering in an ambient material. Neutron interactions with radiochemical detector nuclides provide a window into the structure of the neutron spectrum in the thermonuclear environment.